

# Letters to the Editor

## Experimental Determination of Ground System Performance for HF Verticals — Part 5 (Jul/Aug 2009)

Dear Larry,

The work of Rudy Severns, N6LF — the latest in the Jul/Aug 2009 issue of *QEX* — needs to be made available to a much wider audience. I'd like to suggest that his series be summarized for the *QST* audience which, I believe, is much less technically knowledgeable than that of *QEX*. Better still, his findings should be incorporated in the next edition of *The ARRL Antenna Book*.

The piece by Bob Zavrel, W7SX, in the same issue of *QEX* is a beautiful presentation! For those not as technically inclined: read, and believe the Conclusions on page 33. They effectively refute the mythology and mumbo jumbo heard on the air with increasing frequency. It, too, belongs in the *Antenna Book*.

— Very 73, Jim Olsen Jr, 5905 Landon Ln, Bethesda, MD 20817; w3kmn@aol.co

Hi Jim,

Thanks for the kind words. I hope this information helps people.

— 73, Rudy Severns, N6LF, PO Box 589, Cottage Grove, OR 97424; n6lf@arrl.net

Hi Jim,

Thank you for very much for your comments. ARRL Technical Editor Joel Hallas, W1ZR, has been talking with N6LF about a summary of his *QEX* articles for publication in *QST*.

— 73, Larry Wolfgang, WR1B, *QEX* Editor; lwolfgang@arrl.org

## Maximizing Radiation Resistance in Vertical Antennas (Jul/Aug 2009)

Dear Mr. Zavrel,

The Jul/Aug issue of *QEX* arrived today, and I was just beginning to peruse your article when I noticed repeated references to a publication by "John Krauss." The classic *Antennas* by John D. Kraus has for many years been my Bible for antenna engineering.

Respectfully, unless you are referring to a newcomer of whom I am unaware, the spelling of John's surname remains "Kraus."

I look forward to finishing your article.

— 73, Don T. Batson, W4TTQ, 8442 Antero Dr, Austin, TX 78759; w4ttq@arrl.net

Hi Don,

Thank you for your comments. I hope you enjoyed reading the entire article. Of course, Bob and I both know how to spell Dr. Kraus's last name, and I sincerely apologize for that error! I even had his book out of our Technical Library to check that referenced text. Ten lashes with a wet antenna wire for both of us.

— 73, Larry, WR1B

## Letters, ResCad.exe Program Files Sep/Oct 2009)

Hi Larry,

Thanks for the tip regarding *ResCad* in the Sep/Oct issue of *QEX*. This will be a useful addition to any electronic toolbox. Searching the Web, I found that this little package normally includes a short text file explaining its use. This text file was not part of the package that I downloaded from [www.arrl.org/qexfiles](http://www.arrl.org/qexfiles). The program's author permits the free distribution of the program but suggests that the text file be included in any distribution. The full distribution, including the text file, can be downloaded from [www.armory.com/~rsteve/w/Public/Software/](http://www.armory.com/~rsteve/w/Public/Software/).

I found an interesting comment from Terry Pinnel, a hobbyist in the UK who points out that *ResCad* can be applied to capacitors too, if serial and parallel modes are interchanged. You can read Terry's comments at <http://sci.tech-archive.net/Archive/sci.electronics.basics/2004-11/1310.html>.

I look forward to each issue of *QEX*.

— 73, Dave Green, VE3TLY, 410 Hamilton Ave, Ottawa, ON K1Y 1E1, Canada; ve3tly.gu9z@nfc.ca

Hi Dave,

Thank you for that additional information about *Resistor CAD*. The Web site given in the Sep/Oct Letters column did not include the RESCADREADME.TXT file. I have now downloaded the complete package and placed the new **9x09\_rescad.zip** file on the ARRL *QEX* Files Web site.

— 73, Larry, WR1B

## Some Thoughts on Crystal Parameter Measurement (Letters, Sep/Oct 2008)

Editor, *QEX* Magazine,

Jim Koehler, VE5FP, was kind enough to point out a rather serious typographical error in the crystal resonance equations in

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my letter published in the Sep/Oct 2008 issue of QEX. The parallel-resonant frequencies of maximum impedance ( $f_{pz}$ ) and of zero phase ( $f_{p\phi}$ ) are symmetrically above and below the nominal parallel-resonant frequency, not the series-resonant frequency indicated by the equations as published.

For reference, here is the complete set of equations, hopefully correct this time!

The motional series-resonant frequency is

$$f_{sm} = 1 / (2\pi\sqrt{L_m C_m})$$

where  $L_m$  and  $C_m$  are the motional inductance and capacitance of the standard crystal model (Figure 1).

Including the effects of the motional resistance  $R_m$  and the shunt capacitance  $C_0$ , the series-resonant frequencies of minimum impedance ( $f_{sz}$ ) and of zero phase ( $f_{s\phi}$ ) are

$$f_{sz} = f_{sm} - \Delta$$

$$f_{s\phi} = f_{sm} - \Delta$$

where

$$\Delta = f_{sm} (1/2Q^2)(C_0 / C_m)$$

$$Q = 2\pi \cdot f_{sm} L_m / R_m$$

The nominal parallel resonant frequency (what the parallel resonant frequency would be if  $R_m$  were zero ohms) is:

$$f_{pm} = f_{sm} \sqrt{1 + C_m / C_0}$$

$$\approx f_{sm} (1 + 0.5C_m / C_0)$$

The corrected equations for the parallel-resonant frequencies that include the effect of  $R_m$  are

$$f_{pz} = f_{pm} + \Delta$$

$$f_{p\phi} = f_{pm} - \Delta$$

where  $f_{pz}$  is the frequency of maximum impedance and  $f_{p\phi}$  is the parallel-resonant frequency of zero phase.

One common measurement technique is to place the crystal under test in series between a signal source and measuring device. The source and load impedance are typically 50  $\Omega$ , however lower impedances are used in some test systems for better measurement accuracy. The frequency of maximum transmission of such a pi-network circuit is not equal to any of the three previous definitions of series-resonant frequency. It is

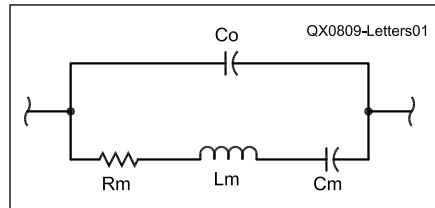


Figure 1—Equivalent circuit for a quartz crystal.

$$f_{\pi} = f_{sm} - \Delta (1 + 4R_T / R_m)$$

Where  $R_T$  is the source and load resistance (assumed equal) in the fixture.

It should be mentioned that the factor  $\Delta$  in

the above equations is an approximation that is most accurate when the ratio of the reactance of  $C_0$  to  $R_m$  is as high as possible. For most crystals the approximation is very good. Some high-frequency overtone crystals have a low-enough Q, however, that the motional resistance may approach the reactance of the shunt capacitance, which degrades the accuracy of the approximation.

— 73, Alan Bloom, N1AL, 1578 Los Alamos Rd, Santa Rosa, CA 95409; n1al@arrl.net

Hi Alan,

Thank you for sending the detailed information about the equations from your earlier letter.

— 73, Larry, WR1B

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